

MODULE	COURSE	YEAR	SEMESTER	CREDITS	TYPE
Underpinning knowledge in Economics and Business Management	Mathematics	1º	1º	6	Foundation
LECTURER(S)			FULL CONTACT INFORMATION FOR OFFICE HOURS (Address, phone number, email, etc.)		
<ul style="list-style-type: none"> <li>Groups A, B: Julia García Cabello</li> <li>Groups C, D: Philippe Bechouche</li> </ul>			<p>Dr. Julia García Cabello Applied Mathematics Dpt. FCEE Phone number 958249031 Room B-05 E-mail: <a href="mailto:cabello@ugr.es">cabello@ugr.es</a></p> <p>Dr. Philippe Bechouche Applied Mathematics Dpt. FCEE : Room B 02 E.T.S.I: Room 5, fifth floor E-mail: <a href="mailto:phbe@ugr.es">phbe@ugr.es</a></p>		
COORDINATOR OF THE COURSE: Philippe Bechouche			OFFICE HOURS		
			Available at <a href="http://www.ugr.es/~mateapli">http://www.ugr.es/~mateapli</a>		
BACHELOR'S DEGREE			ANOTHER BACHELOR'S DEGREE IN WHICH IT CAN BE TAUGHT		
Bachelor's Degree in Economics					



PREREQUISITES AND/OR RECOMMENDATIONS (if necessary)
Pre-university level of mathematics
BRIEF DESCRIPTION OF CONTENT (ACCORDING TO BACHELOR'S DEGREE'S VERIFICATION DOCUMENT)
<p>The contents developed in the program are mathematical calculation and Linear Algebra:</p> <ul style="list-style-type: none"> <li>• Basic concepts of real functions of one variable.</li> <li>• Differential and integral calculus of real functions of one variable.</li> <li>• Optimisation of functions of one variable.</li> <li>• Basics of vectors and matrices.</li> <li>• Solving systems of linear equations.</li> <li>• Matrix diagonalisation.</li> <li>• Numerical sequences and series</li> </ul>
GENERAL, BASIC AND SPECIFIC COMPETENCES
<ul style="list-style-type: none"> <li>• General</li> </ul> <p>CG2 - Cognitive comprehension skills  CG3 - Capacity for analysis and synthesis  CG4- Ability of organization and planning  CG8 - Ability in solving problems  CG9 - Ability in decision making  CG16 - Ability in critical and self-critical reasoning  CG17 - Learning capacity and autonomous work  CG24 - Ability in applying knowledge to practice</p> <ul style="list-style-type: none"> <li>• Basic</li> </ul> <p>CB1 - That students have demonstrated to possess and understand knowledge in an area of study that starts from secondary education, and is usually found at a level that, although supported by advanced textbooks, also includes some aspects that imply knowledge coming from the vanguard of its field of study</p> <p>CB2 – Make the students able to apply their knowledge to their work or vocation in a professional manner Provide them with the skills to elaborate and defend their position and with the problem-resolution abilities in their area of application</p> <p>CB3 - That students have the ability to gather and interpret relevant data (usually within their area of study) to make judgments that include a reflection on relevant issues of social, scientific or ethical nature</p> <p>CB5 - That students have developed those learning skills necessary to undertake further studies with a high degree of autonomy</p>



- Specific

CE11: Knowing and applying basic concepts in Mathematics

CE12: Using the right tools in Linear Algebra and Differential Calculus in economic environments

CE13: Learning integration methods and their application to economic/business scenarios

CE14: Knowing numerical series and learning to compute the sum for geometrical series

## OBJECTIVES (EXPRESSED AS EXPECTED OUTCOMES OF THE LEARNING PROCESS)

- Acquisition of the basic techniques of mathematics.
- Gain the ability to lay out economic and business problems with mathematical language.
- Relate the knowledge acquired with the typical concepts of other subjects of the degree (Statistics, Economic Theory, Accounting ...).
- Solve problems in the economic and business environment using the most appropriate mathematical techniques.
- Analyse the economic and business reality quantitatively.
- Calculate the value of the sums in geometric series.
- Adequately interpret graphs of functions of one variable.
- Calculate derivatives and primitives of elementary functions.
- Solve optimisation of functions of one variable.
- Solve symbolically abstract matrix equations.
- Calculate the determinants of low dimensional square matrices.
- Calculate the inverse matrices of regular low dimensional matrices.
- Calculate and interpret the eigenvalues and eigenvectors of square matrices.
- Apply abstract knowledge to problems formulated with economic terminology.



## DETAILED SYLLABUS OF THE COURSE

THEORETICAL SUBJECT:  
COURSE PROGRAM:

### 1. Basic notions on single-variable functions

- 1.1. Intervals. Domain and range of a function.
- 1.2. Elementary functions. Properties.
- 1.3. Functions in Economics: supply, demand, incomes, costs, benefits, utility.
- 1.4. Limit of a function. Continuity.
- 1.5. Bolzano's theorem. Applications.

### 2. Differential and Integral Calculus of single-variable functions

- 2.1. Derivatives: geometric interpretation and applications.
- 2.2. Derivative of elementary functions. Derivation rules.
- 2.3. Antiderivatives (primitive functions).
- 2.4. Definite integrals. Barrow's rule.

### 3. Optimization of single-variable functions

- 3.1. Increase and decrease intervals. Concave and convex functions.
- 3.2. Local and global extrema. Weierstrass theorem.

### 4. Basic notions on matrices

- 4.1. General knowledge about matrices: notation, operations and properties.
- 4.2. Computing determinants.
- 4.3. Computing the inverse of a matrix.

### 5. System of linear equations

- 5.1. Row reduction. Rank of a matrix.
- 5.2. Gaussian elimination.
- 5.3. Rouché- Fröbenius theorem (Rouché–Capelli theorem). Cramer's rule.
- 5.4. Homogeneous systems.

### 6. Matrix diagonalisation

- 6.1. Computing eigenvalues and eigenvectors
- 6.2. Equivalent matrices. Diagonalisation: the diagonal and the invertible matrices.
- 6.3. Economic applications.

### 7. Sequences and series of real numbers

- 7.1 Sequences of real numbers, operators on sequences, arithmetic and geometric sequences.
- 7.2 Series of real numbers. Convergence and series convergence tests.
- 7.3 Sum of a geometric series.



## PRACTICAL AGENDA:

### 8. Seminars / Workshops:

At least a one seminar will be performed, whose contents will be selected amongst the following ones:

Seminar 1: Demand and supply equations. Surplus and shortages.

Seminar 2: Taylor series approximation.

Seminar 3: Optimization of basic functions in Economics and Business.

This is non-scoring activity.

### 9. Computer-based practices:

Practice 1. Representation of single-variable functions. Derivatives and antiderivatives.

Practice 2. Operating with matrices. Solving systems of linear equations. Matrix diagonalization.

## BIBLIOGRAPHY

### BASIC:

- **García Cabello J., Matemáticas imprescindibles en la Administración de empresas: Ejemplos prácticos y aplicaciones. Ed. Fleming, (2016).**
- Haeussler J.R y Paul R.S. Matemáticas para Administración, Economía, Ciencias Sociales y de la Vida. Ed. Prentice Hall.
- Larson, R B., R P. Hostetler y B. H. Edwards. Cálculo y geometría analítica. Vol. I (9 Ed.) Mc-Graw-Hill, Madrid, (2011).
- Merino, L. M. y E. Santos. Algebra Lineal con métodos elementales. Ed. Thomson, (2006).
- Stewart J. Cálculo Diferencial e integral. Ed. Thomson.
- Sydsaeter, K., Hammond, P.J., Matemáticas para el Análisis Económico. Ed. Prentice Hall.
- Zill, D. y Wright, W. Cálculo de una variable. Mc Graw Hill, (2011)

### OTHER:

- Alegre P. y otros. Matemáticas Empresariales. Ed. AC.
- Balbás A. y otros. Análisis Matemático para la Economía (I y II). Ed. AC.
- Caballero R. y otros. Matemáticas Aplicadas a la Economía y la Empresa. Ed. Pirámide.

## RECOMMENDED LINKS

Platform MATEMAPLI: <http://vvv.ugr.es>

Department of Applied Mathematics: <http://www.ugr.es/~mateapli>



## TEACHING METHODOLOGY

The teaching methodology includes:

- 30% of master classes (45 hours)
- 60% of study and individual work by the student, including the search, checking and treatment of the necessary information sources, solving the problems and case studies and preparing class presentations (90 hours).
- 10% of individual of group tutorials and assessment of the course (15h).

The face-to-face teaching consists of explaining the theoretical topics together with an interactive dialogue and the clarification of doubts (tutoring activities). This will provide the elements of analysis and reflection necessary for the good understanding of the subject.

Practical activities will take place in classrooms and computer rooms. These are compulsory for the good understanding of the fundamentals. They consist of individually (and eventually in groups) resolving practical problems as well as selected readings in relation to each topic raised that will serve to illustrate the contents exposed in class by the professor, allowing thus the analysis and the debate.

In case of monographic works, through individual (and eventually in groups) follow-up tutorials, the teacher will supervise the learning process in order to ensure the assimilation of contents and the acquisition of the corresponding skills.

## ASSESSMENT (ASSESSMENT TOOLS, ASSESSMENT CRITERIA AND PERCENTAGE OF FINAL MARK, ETC.)

According to the Rules for Assessment and grading of the students of the University of Granada (latest changes approved by the Governing Board of 26th October 2016, [http://secretariageneral.ugr.es/bougr/pages/bougr112/\\_doc/examenes%21](http://secretariageneral.ugr.es/bougr/pages/bougr112/_doc/examenes%21)) the assessment of students' academic performance will reflect public, objective and impartial criteria, and will preferably be continuous.

Nevertheless, the students may apply for a single final assessment (article 8 of the current Rules for Assessment, which provides for the taking of a single final assessment). Students may apply for either in the first two weeks of teaching of the subject or two weeks following change of matriculation. Application is to be made through the electronic system (<https://sede.ugr.es/sede/catalogo-de-procedimientos/solicitud-evaluacion-unica-final.html>), citing and accrediting the reasons for not being able to undergo the system of continuous assessment (reasons of employment, health, disability or any other correctly justified cause), with the understanding that this assessment is undertaken in a single academic act in order to accredit that the student has acquired in full the competencies described.

On one hand, lack of application for a single final assessment will be understood as a waiver of the right of such assessment. On the other hand, those students who have been granted a single final assessment are not eligible to apply for a continuous assessment.

In the continuous assessment, that attendance to the corresponding assessment activities is obligatory. Lack of attendance to the assessment activities on the dates and the places specified for it will be understood as a waiver of the right of performance of these activities. Dates and places for assessment activities will be made public sufficiently in advance.



### 1. General assessment

In the continuous assessment option, the total score is the sum of all scores corresponding to assessment activities. These are the following:

- Two test-type controls throughout the semester: the first one corresponding to units 1, 2 and 3 and the second one corresponding to units 4, 5, 6 and 7. They are non-elimatory while containing both theory and practical questions (including those of seminars and computer practicals) related to the matter of study. Each of these is scored a maximum of 1 point.
- Additional tests which consist of essays, online tests, face-to-face problem solving, attendance and active student participation in class (objective tests, cases or assumptions, short answer tests) and all those activities considered appropriate by the professor in order to evaluate the different knowledge and skills acquired. The total of these activities scores a maximum of 1 point.
- A final written exam which scores a maximum of 7 points (70% weight versus 30% weight corresponding to all other assessment activities). Date and place for the final written exam will be made public by the Faculty of Economic and Business Sciences.

Students with no attendance to the final written exam (that scores a maximum of 7 points, i.e., 70% weight) will have the final mark "Not Having Been Submitted" ("No Presentado").

### 2. Extraordinary assessment

It will consist of a single written exam which will be graded on a 0-10 scale (scoring a maximum of 10 points). In order to pass the course under this option, a final mark equal or bigger than 5 is required. Otherwise, the course is considered to be failed. Date and place for the final written exam will be made public by the Faculty of Economic and Business Sciences.

Students with no attendance to such final written exam (that scores a maximum of 10 points) will have the final mark "Not Having Been Submitted" ("No Presentado").

### ADDITIONAL INFORMATION

- PRADO online platform
- Matemapli online platform
- Student Guides, where schedules, methodologies, timetables are fully described [https://fccee.ugr.es/pages/docencia/guias\\_titulaciones](https://fccee.ugr.es/pages/docencia/guias_titulaciones)
- Rules for Assessment and grading of the students of the University of Granada (article 8) [http://secretariageneral.ugr.es/bougr/pages/bougr112/\\_doc/examenes%21](http://secretariageneral.ugr.es/bougr/pages/bougr112/_doc/examenes%21)



**SCENARIO A (ON-CAMPUS AND REMOTE TEACHING AND LEARNING COMBINED)**

**TUTORIALS**

**TIMETABLE**

(According to Official Academic Organization Plan)

**TOOLS FOR TUTORIALS**

(Indicate which digital tools will be used for tutorials)

Available at: <http://mateapli.ugr.es>

Tutorial will be mainly conducted by either Google Meet or the UGR email .

- Individual tutorials shall be appointed upon students's request
- Group tutorials could be proposed by the lectures when necessary

**MEASURES TAKEN TO ADAPT TEACHING METHODOLOGY**

- According to the UGR Normative for Adapting the Teaching to the COVID situation held in the academic course 2020-2021 and approved by the Governing Board of UGR on 25-06-20, in scenario A teaching is considered as a multimodal (hybrid) system combining as many face-to-face activities as possible with virtual/online activities (synchronous sessions) together with formative actions in order to boost the autonomous students learning.
- The ratio between these two types of learning (face-to-face and virtual one) shall be fixed by the Faculty of Business and Economics depending on the Sanitary Authorities' s dictations. Virtual sessions should be focus on theoretical issues while the face-to-face activities shall be devoted to both resolving problems and the corresponding assessment sessions.
- Computer practicals shall be carried out in a virtual mode in order to prevent infection by personal contact.
- Virtual sessions shall be performed through the UGR authorized online platforms (Google Meet for instance) with synchronous activities as a priority. However, if Sanitary Authorities should impose an asynchronous scenario, all sessions should be recorded/streamed and stored in Google drive to be shared with all students. In such case, complementary activities (tutorials, seminars...) shall be carried out in order to strengthen training of students. Homework submission shall be performed throughout the UGR authorized online platforms: Prado, Google Meet, Google Drive or by means of the UGR email.
- Additionally, special attention shloud be paid to delivering teaching material to students throughout the online platforms Prado and/or Google Drive.



MEASURES TAKEN TO ADAPT ASSESSMENT (Instruments, criteria and percentage of final overall mark)

**Ordinary assessment session**

In the continuous assessment, that attendance to the corresponding assessment activities is obligatory. Lack of attendance to the assessment activities on the dates and the places specified for it will be understood as a waiver of the right of performance of these activities.

In order to pass the course under this option, a final mark equal o bigger than 5 is required. Otherwise, the course is considered to be failed. Dates and places for assessment activities will be made public sufficiently in advance.

In the continuous assessment option, the total score is the sum of all scores corresponding to assessment activities. These are the following:

- Six test-type controls throughout the semester corresponding to units 1, 2, 3, 4, 5 and 6. They are non-eliminatory while containing both theory and practical questions (including those of seminars and computer practicals) related to the matter of study. Each of these is scored a maximum of 1 point. These shall be carried out throughout the Prado platform in case that face-to-face assessments are not allowed for the Sanitary Authorities' s dictations.
- Two additional exams on computer practicals which score 0.5 points each. These shall be carried out throughout the Prado platform in all cases.
- A final written exam which scores a maximum of 3 points (30% weight versus 70% weight corresponding to all other assessment activities). Date and place for the final written exam will be made public by the Faculty of Economic and Business Sciences. These shall be carried out throughout the Prado platform in case that face-to-face assessments are not allowed for the Sanitary Authorities' s dictations.

**Extraordinary assessment session**

It will consist of a single written exam which will be graded on a 0-10 scale (scoring a maximum of 10 points). In order to pass the course under this option, a final mark equal o bigger than 5 is required. Otherwise, the course is considered to be failed. Date and place for the final written exam will be made public by the Faculty of Economic and Business Sciences. These shall be carried out throughout the Prado platform in case that face-to-face assessments are not allowed for the Sanitary Authorities' s dictations.

Students with no attendance to such final written exam (that scores a maximum of 10 points) will have the final mark "Not Having Been Submitted" ("No Presentado").



## Single final assessment

According to the Rules for Assessment and grading of the students of the University of Granada (latest changes approved by the Governing Board of 26th October 2016, [http://secretariageneral.ugr.es/bougr/pages/bougr112/\\_doc/examenes%21](http://secretariageneral.ugr.es/bougr/pages/bougr112/_doc/examenes%21)) the assessment of students' academic performance will reflect public, objective and impartial criteria, and will preferably be continuous.

Nevertheless, the students may apply for a single final assessment (article 8 of the current Rules for Assessment, which provides for the taking of a single final assessment). Students may apply for either in the first two weeks of teaching of the subject or two weeks following change of matriculation. Application is to be made through the electronic system (<https://sede.ugr.es/sede/catalogo-de-procedimientos/solicitud-evaluacion-unica-final.html>), citing and accrediting the reasons for not being able to undergo the system of continuous assessment (reasons of employment, health, disability or any other correctly justified cause), with the understanding that this assessment is undertaken in a single academic act in order to accredit that the student has acquired in full the competencies described.

On one hand, lack of application for a single final assessment will be understood as a waiver of the right of such assessment. On the other hand, those students who have been granted a single final assessment are not eligible to apply for a continuous assessment.

Single Final Assessment shall consist of a single written exam which will be graded on a 0-10 scale (scoring a maximum of 10 points). In order to pass the course under this option, a final mark equal or bigger than 5 is required. Otherwise, the course is considered to be failed. Date and place for the final written exam will be made public by the Faculty of Economic and Business Sciences. These shall be carried out throughout the Prado platform in case that face-to-face assessments are not allowed for the Sanitary Authorities' s dictations.

Students with no attendance to such final written exam (that scores a maximum of 10 points) will have the final mark "Not Having Been Submitted" ("No Presentado").



SCENARIO B (ONCAMPUS ACTIVITY SUSPENDED)

TUTORIALS

TIMETABLE

(According to Official Academic Organization Plan)

Available at: <http://mateapli.ugr.es>

TOOLS FOR TUTORIALS

(Indicate which digital tools will be used for tutorials)

Tutorial will be mainly conducted by either Google Meet or the UGR email .

- Individual tutorials shall be appointed upon students's request
- Group tutorials could be proposed by the lectures when necessary

MEASURES TAKEN TO ADAPT TEACHING METHODOLOGY

- According to the UGR Normative for Adapting the Teaching to the COVID situation held in the academic course 2020-2021 and approved by the Governing Board of UGR on 25-06-20, in scenario B teaching is considered as virtual in all its activities with a major priority for synchronous sessions.
- In case of an asynchronous scenario should be imposed, virtual sessions shall be performed through the UGR authorized online platforms (Google Meet). In an asynchronous scenario, all sessions should be recorded/streamed and stored in Google drive to be shared with all students. In such case, complementary activities (tutorials, seminars...) shall be carried out in order to strengthen training of students.
- Homework submission shall be performed throughout the UGR authorized online platforms: Prado, Google Meet, Google Drive or by means of the UGR email.
- Computer practicals shall be carried out in a virtual mode in order to prevent infection by personal contact.
- Additionally, special attention should be paid to delivering teaching material to students throughout the online platforms Prado and/or Google Drive.



MEASURES TAKEN TO ADAPT ASSESSMENT (Instruments, criteria and percentage of final overall mark)

### Ordinary assessment session

In the continuous assessment, that attendance to the corresponding assessment activities is obligatory. Lack of attendance to the assessment activities on the dates and the places specified for it will be understood as a waiver of the right of performance of these activities.

In order to pass the course under this option, a final mark equal o bigger than 5 is required. Otherwise, the course is considered to be failed. Dates and places for assessment activities will be made public sufficiently in advance.

In the continuous assessment option, the total score is the sum of all scores corresponding to assessment activities. These are the following:

- Six test-type controls throughout the semester corresponding to units 1, 2, 3, 4, 5 and 6. They are non-eliminatory while containing both theory and practical questions (including those of seminars and computer practicals) related to the matter of study. Each of these is scored a maximum of 1 point. These shall be carried out throughout the Prado platform.
- Two additional exams on computer practicals which score 0.5 points each. These shall be carried out throughout the Prado platform.
- A final written exam which scores a maximum of 3 points (30% weight versus 70% weight corresponding to all other assessment activities). Date and place for the final written exam will be made public by the Faculty of Economic and Business Sciences. These shall be carried out throughout the Prado.

### Extraordinary assessment session

It will consist of a single written exam which will be graded on a 0-10 scale (scoring a maximum of 10 points). In order to pass the course under this option, a final mark equal o bigger than 5 is required. Otherwise, the course is considered to be failed. Date and place for the final written exam will be made public by the Faculty of Economic and Business Sciences. These shall be carried out throughout the Prado platform.

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## Single final assessment

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ASSESSMENT (ASSESSMENT TOOLS, ASSESSMENT CRITERIA AND PERCENTAGE OF FINAL MARK, ETC.)

Firma (1): MIGUEL ANGEL PIÑAR GONZALEZ  
En calidad de: Director/a de Departamento



UNIVERSIDAD  
DE GRANADA

INFORMACIÓN SOBRE TITULACIONES DE LA UGR  
[grados.ugr.es](https://grados.ugr.es)



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#### Extraordinary assessment

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